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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A new technique using the aero-infiltrometer to characterise the natural soils based on the measurements of infiltration rate and soil moisture content" *by* M. A. Fulazzaky et al.

Anonymous Referee #3

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The authors present a study in which air and water infiltration tests were performed in three soils, and empirical relationships were developed between the two. It is commendable that the authors seek to develop new methods to characterize soils and understand water and gas movement through them. Their new aero-infiltrometer is an interesting instrument, which could have use in understanding vadose zone processes. However, the paper as written has serious deficiencies which need to be addressed.

- The introduction is lacking in focus and depth of the methods being used in the study

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- The units should be put into SI

- The choice of the symbol Lp for pressure drop is curious, since L is generally associated with length terms

- The authors claim that the nozzle of their aero-infiltrometer is analogous to the inner ring of a double ring infiltrometer (DRI), which does not hold up to reason. The purpose of the inner ring of a DRI is for creating 1-d flow conditions, which is clearly not the case with the aero-infiltrometer.

- There is no discussion of the DRI setup and how the tests were performed

- There is no discussion of DRI theory, nor mention of the many solutions which have been developed over the past 80+ years to interpret infiltration results.

- The authors base their infiltration analysis on Horton's equation, which specifies that rainfall intensity is greater than infiltration rate. The coarse soils used in the study, with infiltration rates greater than 2 cm-hr-1, would seem to invalidate this requirement.

- The authors should realize that the infiltration rates observed in their DRI depend on the upper boundary conditions imposed in the test. The observed infiltration rate will vary as a function of head.

- The authors claim that air pressure drop will depend on capillary forces, which does not make sense. Instead, the authors should realize that one key difference between air and water infiltration is that water is pulled by capillary forces (as wetting front potential), whereas air is not. This distinction may make it difficult to develop a fundamental relationship between the two (though permeability can be measured using both water and air).

- The authors acknowledge that soil has high variability, yet assume that air and water infiltration tests performed 1 meter apart reflect identical soil conditions.

- Equation (4) would only work if the infiltration front stopped advancing. Also, the

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authors seem to be describing degree of saturation (S), which scales from 0 to 100%, rather than water content.

- The three curves relating Pressure drop to infiltration rate (Figure 4) have very different shapes. Even though it is possible to describe them all with a power function, there does not appear to be a true predictive relationship between the two parameters.

- Since the results presented in Figure 4 do not suggest a predictive (fundamental) relationship between infiltration rate and air pressure drop, infiltration tests would need to be performed at every site anyway, which would seemingly defeat the purpose of using the aero-infiltrometer.

- The authors state that it is cumbersome and inconvenient to use single or double ring infiltration rings, yet the proposed method relies on an instrument with a valve, an air pump, a pressure gauge and nozzles. It seems that the ring infiltrometer are relatively simple and easy to use, and have the benefit of actually measuring the parameter of interest.

In spite of the deficiencies stated above, I do not wish to discourage the authors, as their instrument is a good idea and has potential to help us better understand the vadose zone. I encourage the authors to continue to develop this instrument and its applications.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 12717, 2013.